

# **NAVAL POSTGRADUATE SCHOOL**

## **Monterey, California**



## **THESIS**

**RECONSTITUTION COSTS OF AIRCRAFT LAUNCH AND  
RECOVERY EQUIPMENT DUE TO CONTINGENCY  
OPERATIONS**

by

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June 2001

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**RECONSTITUTION COSTS OF AIRCRAFT LAUNCH AND RECOVERY  
EQUIPMENT DUE TO CONTINGENCY OPERATIONS**

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Submitted in partial fulfillment of the  
requirements for the degree of

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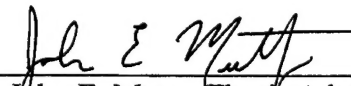
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## **ABSTRACT**

Since the end of the Cold War, the United States Navy has been involved in many peacekeeping and disaster relief operations worldwide. Most of these Operations Other Than War (OOTW) have been unanticipated and therefore unbudgeted. The marked increase in the occurrence of these contingency operations compelled Congress to establish the Overseas Contingency Operations Transfer Fund (OCOTF) in 1997. This fund is used to reimburse the service components for their expenditures in support of contingency operations. However, due to the uncertainty involved in these contingencies, the Department of the Navy (DoN) has found it very difficult to estimate and subsequently identify costs associated with the contingency operations. This thesis develops a defensible method of assigning Aircraft Launch and Recovery Equipment (ALRE) maintenance and repair costs to contingency operations based on the number of sorties flown. The model was derived through regression analysis of catapult shots using underway days and Primary Mission Readiness (PMR) as explanatory variables. This model should aid the DoN in both predicting and identifying costs attributable to contingency operations and lend credibility to the DoN's request to the Office of Management and Budget (OMB) for reimbursement.

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## **I. BACKGROUND/ INTRODUCTION**

### **A. HISTORY OF THE OVERSEAS CONTINGENCY OPERATIONS TRANSFER FUND (OCOTF)**

As U.S. spending on peacekeeping activities soared in the early 1990's, Congress became increasingly concerned about the costs of U.N. and U.S. peacekeeping operations. For FY91, DoD listed incremental costs for peacekeeping and related activities in Iraq/Kuwait of \$346.5M (\$325M for Provide Comfort humanitarian assistance programs and \$21.5M in assistance to the United Nations Iraq-Kuwait Observation Mission). For FY92, total incremental costs were \$125.0M for operations in Iraq/Kuwait, Somalia, ex-Yugoslavia, Haiti, Cambodia, the Western Sahara, and Angola. Costs increased sharply in FY93 (\$2.165B) due to Operation Restore Hope in Somalia and then stayed relatively high in FY94 and FY 95 at \$1.907B and \$2.223B, respectively. [Ref. 15, p.6] Increased costs created concern in Congress over the appropriate mechanism for funding such operations.

The increase in peacekeeping operations concerned the administration as well. In the wake of the deaths of U.S. special operations forces in Somalia in the fall of 1993, President Clinton decided to define a more restrictive role for peacekeeping. President Clinton outlined these tighter guidelines for U.S. military support of multilateral peacekeeping operations in May of 1994 through Presidential Decision Directive (PDD) 25.

Under PDD 25, U.S. support of multilateral peacekeeping operations was to hinge on whether "there is a threat to or breach of international peace and security." Situations involving international aggression, a humanitarian disaster in a violent situation, or the

sudden interruption of an established democracy, or gross violation of human rights were identified as valid bases for U.S. involvement. U.S. troop involvement required further criteria to be met, such as acceptable risks to U.S. troops, availability of resources, essentiality of U.S. involvement for operational success, and the existence of domestic and congressional support. Following PDD 25, debate in Congress over U.S. involvement in peacekeeping operations intensified.

As the U.S. military was increasingly called upon to perform peacekeeping and other non-combat missions, members of Congress questioned the effect of peacekeeping operations upon the U.S. Armed Forces' readiness to conduct their primary mission of combat warfare. When Defense Secretary Perry announced that several army units had less than acceptable readiness levels in 1994, Congress' fears were affirmed. Secretary Perry blamed the problem on a cash flow shortage created by the diversion of Operations and Maintenance (O&M) funds to peacekeeping and other unplanned deployments.

As a result of the growing costs and ongoing debate over the degradation of military readiness, the 103rd and 104th Congresses sought to develop new procedures and mechanisms for budgeting contingency operations costs. The traditional method of funding the incremental costs that the U.S. military incurs in assisting and participating in U.N. and other peacekeeping activities was through absorption by existing DoD budgets. Funds were obtained through appropriation transfers or reprogramming and only occasionally through supplemental appropriations. Although the services were eventually reimbursed for a majority of their costs under these processes, DoD activities still suffered because unobligated funds were taken from other accounts (mainly troop training and maintenance and repair) to cover such costs. The impact was especially

pronounced when peacekeeping operations resulted in unexpected costs late in the fiscal year. With limited funds remaining for transfer, cancellation of training and maintenance was required to provide the necessary funding for peacekeeping operations.

In a 1994 report prepared by the GAO, five alternatives to fund the increased costs of conducting Operations Other Than War (OOTW) were proposed [Ref. 18, p.3]:

1. Use Defense Business Operations Fund (DBOF) to fund costs
2. Authorize increased transfer and reprogramming levels for defense appropriations
3. Establish a revolving fund
4. Establish a transfer account
5. Provide direct appropriations to each service

The Clinton administration had its own ideas for dealing with the monetary burden of these unbudgeted operations. In 1993, President Clinton pushed for a Global Cooperative Initiatives (GCI) account. The GCI account would serve as a repository for funds for peacekeeping, humanitarian assistance, and disaster relief. [Ref. 15, p.4] Congress rejected Clinton's proposal since the GCI account funds could be used at the discretion of the administration without the approval of Congress. In 1995, the administration made a counterproposal in the form of the Readiness Preservation Authority (RPA). Instead of funding unbudgeted operations, RPA would allow DoD to obligate for essential readiness in the second half of the fiscal year without an appropriation. [Ref. 16, p.4] The purpose of RPA was to alleviate fourth quarter



shortfalls incurred by the services when unbudgeted operations took place in the last half of the fiscal year and were consequently not reimbursed until the next fiscal year.

Congress ultimately rejected the RPA on the basis that it would erode the control of the State Department and Congress on actions taken in support of peacekeeping. Instead, the 104<sup>th</sup> Congress authorized advanced funding for ongoing peacekeeping operations in the FY96 Appropriation Bill (Public Law 104-61). The bill contained \$647M in support of ongoing operations in Iraq (Operations Provide Comfort and Southern Watch), to be available only after the funds were requested and the costs detailed in the FY97 budget request. Since FY97, Congress has appropriated funds for Southwest Asia operations (Operations Northern and Southern Watch in Iraq) within the Overseas Contingencies Operations Transfer Fund (OCOTF). As described in the FY01 Secretary of Defense Operations and Maintenance Overview [Ref. 9, p.75]:

The OCOTF was established to meet operational requirements in support of contingency operations without disrupting approved program execution or force readiness. The OCOTF is a 'no year' transfer account, and provides additional flexibility to meet operational requirements by transferring assets to the Military Components based on actual execution experience as events unfold during the year of execution.

This fund was established by the Senate Appropriations Committee in the FY97 Defense Appropriations Bill as a consolidated fund site for operations and maintenance monies for ongoing contingency operations. Despite the advanced set-asides for these operations, annual supplemental appropriations have still been necessary. Additional operations due to the expanded missions in the Balkans (Bosnia) have required the

passage of supplemental appropriations in order to cover costs incurred by the services. However, due to the Budget Enforcement Act (BEA) of 1990, these supplemental appropriations oftentimes require rescissions in order to meet the top-line threshold for DoD. Routinely, these rescissions are taken from modernization and procurement accounts. Alternately, military commanders have had to forego training in the late stages of the fiscal year in order to compensate for supplemental appropriations.

Recently, the OCOTF has ceased to fund operations in Southwest Asia. According to Program Budget Decision (PBD) 096, dated 19 December 2000, the "department no longer considers operations in Southwest Asia to be contingency operations since these operations have been ongoing for ten years and there appears to be no plan to withdraw forces in the near term." [Ref. 11, p.3] Thus, as of FY02, the services will be required to estimate their costs for Operations Northern and Southern Watch and annotate their budget requests appropriately. If future predictions of costs fall below actuals, the service components will bear the additional costs.

## **B. INCREMENTAL COSTS**

One of the difficulties in funding contingencies has been the identification and justification of incremental costs for supporting a designated operation. The DoD Financial Management Regulation (DoDFMR, DoD 7000.14-R) defines incremental costs as those costs that are above and beyond baseline training, operations, and personnel costs. In essence, incremental costs with respect to contingency operations can be succinctly defined as those costs that would not be incurred except for participation in the contingency. [Ref. 12, p.13] The requirement to budget for contingency operating

costs is set forth in Chapter 17 of the DoDFMR. However, despite the four-year existence of the OCOTF, little guidance has been given to the services regarding acceptable methods of determining incremental costs. As a result, the services have adopted various methodologies that have been moderately successful as justification to OMB and Congress. Chapter 23 of Volume 12 to the DoDFMR, entitled, "Contingency Operations," will be the first comprehensive formalized guidance to the services. It is presently in draft form.

According to the instructions in Chapter 17 of the DoDFMR, incremental costs are divided into four subcategories: personnel, personnel support, transportation, and operating support. The personnel subcategory is further divided into military and civilian personnel costs. The military personnel costs consist of not only subsistence and base pay for reservists called into action, but also additional pay for active duty personnel such as family separation allowances and imminent danger or hostile duty pay. Civilian costs include wages for additional civilian temporary hires and allowances such as civilian premium pay. The personnel support category covers additional medical support and health services required for the contingency operation and support equipment, supplies and clothing. The transportation category covers the costs of airlift, sealift, port handling and other transportation costs associated with the logistics tail of the operation. Lastly, operating support entails the training costs, Petroleum, Oil and Lubricants (POL), supplies, Command, Control, Communications, Computers and Intelligence (C4I), facilities support, and reconstitution costs. In FY00, 71% of the total contingency incremental costs requested by the DoN fell under operating support costs. [Ref. 17, p.6]

Due to the lack of formal guidance for the services in providing estimates for incremental costs associated with contingency operations, several different methodologies emerged. The most glaring differences occurred in the component flying hour programs. The Air Force designated any flying hours over their budgeted Active Duty base flying hours as incremental. Furthermore, they counted all Reserve and National Guard missions in support of contingencies as incremental.

The Navy computed its incremental flying hours quite differently. In fact, the methods used by the Navy's Atlantic and Pacific Fleets not only differed substantially from the Air Force method, but also differed from one another. The Atlantic Fleet calculated the number of training sorties that would have occurred had the contingency not taken place and labeled any flying hours above that "normal OPTEMPO" as incremental. The Pacific Fleet, however, recognized training value in all flights regardless of their mission and decided upon a median training value of 40% for all flights for contingency operations. Therefore, the Pacific Fleet deemed that 60% of the costs for all contingency flying hours were incremental. [Ref. 17, p.6] These disparate methodologies were generally accepted by OMB until FY00 when they mandated that the Navy's two Fleets decide upon a single methodology for FY01.

### **C. RECONSTITUTION COSTS**

The concept of incremental costs for contingency operations has been particularly elusive and difficult to justify when addressing reconstitution costs. Categories such as personnel costs have clearly defined incremental costs in the form of foreign duty pay and wages for reservists called to active duty. Reconstitution, however, intertwines a

host of variables that are not so easily disentangled. Reconstitution costs, as defined in the DoDFMR, include the cost to clean, inspect, maintain, replace, and restore equipment to the required condition at the conclusion of the contingency operation. Reconstitution covers equipment organic to the participating unit and war reserve stocks prior to replacement into storage, but excludes the cost to transport equipment being repaired and/or restored. Typically, reconstitution occurs at the conclusion of an operation or upon the transfer of operational control for equipment from one unit to another.

#### **D. BENEFITS OF THE STUDY**

Agency estimates of contingency operation costs have greatly improved over time, but still require significant improvement. The host of General Accounting Office (GAO) and Congressional Research Service (CRS) reports on the topic of contingency funding is a testament to the level of importance Congress places upon the accuracy of contingency cost estimating and accounting. The service components are equally concerned, given the millions of dollars in unreimbursed expenditures made over the past decade on contingency operations.

Unfortunately, cost estimation is merely half of the battle. Documentation and consequently justification of incremental costs continues to present a much greater challenge to agency budget personnel. While overall cost estimates have markedly improved, the services continue to struggle with matters of accounting. Declining budgets, unclear budgetary guidance, and past material misstatements have cast a shadow upon the trustworthiness of agency requests for additional funding. The defensibility of cost estimation and accounting methods has become as important as the costs themselves.

The absence of clear budgetary guidance in the early periods of contingency funding is to blame for much of today's continuing problems. Left to their own devices, the services developed independent methods for determining incremental costs. As a result, practices differ not only between services but among them as well. The absence of standardization breeds a lack of confidence in reliability. In order to garner Congressional confidence in agency funding requests, a common and defensible methodology must be used to determine and calculate incremental costs. The draft chapter of the DoDFMR on Contingency Operation Costing will aid in defining allowable incremental cost. However, it does not define a common methodology for calculating incremental costs.

This study presents a defensible method for calculating incremental maintenance and repair costs for Aircraft Launch and Recovery Equipment (ALRE) associated with contingency operations. It is my hope that this methodology may be equally applied to other shipboard systems, thereby creating a common, accepted methodology. Adoption of a single methodology will simplify the accounting process for budget personnel. In turn, a well-defined and simplified process will increase the reliability and accuracy of accounting data. More reliable and accurate data not only provide for better estimates, but also reduce the likelihood that Congress will reject agency funding requests.

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## II. DATA COLLECTION

### A. AIRCRAFT LAUNCH AND RECOVERY EQUIPMENT

#### 1. Program Management

Aircraft Launch and Recovery Equipment (ALRE) blurs the division between naval air and naval sea systems. ALRE encompasses all equipment and systems for launch and recovery of aircraft, including catapults, arresting gear, helicopter landing systems, visual and optical landing aids, information systems, wind measuring systems, aviation marking and lighting installed in ships, and recovery systems and visual landing aids installed ashore. [Ref. 1, p.3] Although nearly all ALRE components are integral to the ship, NAVAIR exercises overall program management. The ALRE Program Office is located at the system command's headquarters in Patuxent River, Maryland. As described in NAVAIRINST 5400.149A, *Designation of the Aircraft Launch and Recovery Equipment Program Manager Air (PMA251)*, PMA 251 is responsible for the acquisition and logistics support of ALRE systems installed in ships, aircraft and ashore, from research and development through test and evaluation, acquisition, and modernization to system disposal. [Ref. 1, p.5]

The enormity of cradle to grave responsibility cannot be underestimated. The present PMA251 Flight Integration Project Team Leader admits that his focus is divided into three areas: acquisition, in-service changes, and recapitalization. The day-to-day tracking of system performance and reliability is delegated to the Type Commanders (TYCOM) and the Naval Air Systems Command, Lakehurst in New Jersey. The TYCOM oversees ALRE training and maintenance documentation, conducts inspections and lends assistance through maintenance management teams. Naval Air Systems



Command, Lakehurst serves as a central source of ALRE program in-service data analysis and ALRE technical expertise.

## **2. Organizational Level Maintenance**

ALRE organizational level maintenance is accomplished via Planned Maintenance System (PMS) cards under the shipboard Maintenance and Material Management (3M) system. Similarly, ALRE organizations use the Organizational Maintenance Management System (OMMS) to report operational maintenance accomplishment. Although ALRE is governed by these shipboard maintenance and repair management systems, aviation ratings within V-2 division perform maintenance on ALRE components. As a result, the NAVAIR ALRE oversight organizations also require ALRE organizational maintenance units to document PMS according to the Aircraft Launch and Recovery Equipment Management Program (ALREMP). ALREMP was designed to establish standard procedures of quality assurance and maintenance control for ALRE. The requirements of ALREMP are outlined in OPNAVINST4700.15C.

At each TYCOM, ALREMP management teams have been established to support the organizational units in complying with the Aircraft Launch and Recovery Management Program. One of the primary responsibilities of these management teams is to conduct assist visits and annual formal audits of each ship. Assist visits are informal and advisory in nature and are normally scheduled following a ship's Selected Restricted Availability (SRA) or during the ship's work-up cycle. Typically, the formal audits occur just prior to or at the mid-point of the ship's deployment. [Ref. 3, p.2]

### **3. Intermediate/Depot Level Maintenance**

Once again, ALRE does not conform to the norm with regard to intermediate and depot level maintenance. Normally, either Ship's Intermediate Maintenance Activities (SIMA) or Aviation Intermediate Maintenance Departments (AIMD) would perform intermediate level maintenance. Since each carrier is designated as an IMA, the CV/CVN AIMD would be the first source for performance of echelon II maintenance. However, the Maintenance Officer in charge of V-2 division aboard aircraft carriers is given much more leeway in determining who performs intermediate and depot level maintenance. There are very few evolutions that are required by regulation to be performed by inorganic maintenance organizations. Therefore, many intermediate level maintenance items are performed by ship's force. If the Maintenance Officer deems that required intermediate maintenance is beyond the capabilities of ship's force, he requests authorization from the TYCOM for a Naval Aviation Depot to accomplish the work.

Naval Aviation Depots (NADEP) are the primary aviation industrial establishments for depot level maintenance. [Ref. 13, p.13-9] Within the NADEPs in Jacksonville, Norfolk, and San Diego exist specially-trained shipyard technicians called Voyage Repair Team (VRT) personnel. These personnel are certified by Naval Air Systems Command, Lakehurst to conduct depot level maintenance on ALRE components. VRTs are often tasked to make unscheduled depot level repairs in theater. Private and government-owned shipyards are also authorized to conduct depot level maintenance on ALRE. Once again, the allocation of work is determined by the appropriate TYCOM.

Thus, the TYCOM is the decision-maker for intermediate and depot-level maintenance. Specifically, the Ship Installation Officer (N433) under COMNAVAIRLANT and the Air Systems Officer (N435) under COMNAVAIRPAC act as the TYCOM representatives. These individuals screen, coordinate and direct all work and funding for ALRE to include coordination with the surface community in support of ALREMP.

#### **4. Reporting/Trend Analysis**

As discussed above, organizational maintenance on ALRE is reported via the Organizational Maintenance Management System (OMMS). ALREMP, however, requires additional data collection and reporting. The main recipient of this additional data is Naval Air Systems Command, Lakehurst. Monthly, each ship submits launch and recovery data via the Automated Shot and Recovery Log (ASRL) system to Naval Air Systems Command, Lakehurst. On a quarterly basis, commands must submit a Flight Deck Operations Report to Naval Air Systems Command, Lakehurst. Naval Air Systems Command, Lakehurst compiles the data and computes parameters such as mean shots to failure for various ALRE components.

### **B. SOURCES OF INFORMATION**

#### **1. Technical/Operational Sources**

As described above, the TYCOMs play a central role in the technical and operational decisions regarding ALRE. The COMNAVAIRLANT and COMNAVAIRPAC Ship Installation Officers (N433 and N435) control the scheduling of the ALRE management teams and the voyage repair teams. These TYCOM representatives also screen the ships' Current Ship's Maintenance Projects (CSMP) and

program echelon II and III maintenance accomplishment among the various intermediate and depot level maintenance facilities.

Naval Air Systems Command, Lakehurst is another valuable source of technical information. As the cognizant field activity for ALRE, Naval Air Systems Command, Lakehurst is responsible for research and development, test and evaluation, and in-service engineering of ALRE. As part of their in-service engineering duties, Naval Air Systems Command, Lakehurst provides technical and logistics support to the fleet activities. The Carrier and Field Service Unit (CAFSU) of Naval Air Systems Command, Lakehurst sponsors a team of highly skilled civilian technicians located at various CONUS field offices (and one in Yokosuka, Japan) to assist operational units in repairing and testing ALRE. Although a branch of Naval Air Systems Command, Lakehurst, CAFSU is under the operational control of CAFSU Supervisors located at each TYCOM.

The operational units themselves are important data points as well. Often times, the underlying reasons for trends cannot be derived from aggregate reports collected at the Immediate Superior In the Chain of Command (ISIC) level. Maintenance Chiefs and Catapult Officers can provide important insight by grounding the statistics in a "deck plate" level assessment. Any analysis without their input would be incomplete.

## **2. Budgetary Sources**

The topic of contingency costing has been addressed at high levels in the executive and legislative branches of the federal government. In the executive branch, the Office of Management and Budget and the Office of the Undersecretary of Defense (Comptroller) have promulgated various memoranda to service component budget personnel outlining the format for submission of contingency budget requests and actual costs. In the DoN, these submissions are channeled through the Navy's Office of Budget

(FMB) for consolidation and review. These documents are important benchmarks for establishing successful criteria for justification of reconstitution cost requests. In the legislative branch, the Congressional Research Service (CRS) and General Accounting Office (GAO) have conducted various studies on contingency costing and accounting at the behest of Congressional members over the past decade. These studies will supplement the OMB guidance and past Program Budget Decisions (PBD) regarding the level of justification required for reconstitution budget requests.

Maintenance cost data are the focal point of this research. Reconstitution costs due to contingency operations are most notably manifested in an increase in maintenance costs following an extended operation away from industrial facilities with the capability to perform echelon II and III maintenance actions. Intermediate and depot level availability cost trends are therefore valuable data points for determining the effects of contingency operations on the reconstitution effort.

## **C. DATA COLLECTION METHODS**

### **1. Review of Regulations and Reports**

Literary reviews are an essential starting point to gain an appreciation for the complexity of contingency operation budget estimation and cost accounting. The evolving budgetary guidance of the DoD Financial Management Regulation (DoDFMR) provides a picture of how the agencies are grappling with the difficulties of incremental cost separation and cost accounting in complex contingency operations. Programming Budget Decisions provide great insight into the Department of Defense's self-assessment in budgeting and justifying incremental contingency costs. Previous research reports and

former studies by the GAO and CRS serve as external assessment of the level of agency success in accurately capturing contingency costs. The General Accounting Office has been especially prolific in researching past budget submissions and actual costing of contingency operations.

In the operational spectrum, maintenance and training policy instructions are essential for the derivation of offsets and explanation of costs in excess of the norm due to operational requirements or deficiencies. Inspection reports from various groups such as the Inspector General's office and the TYCOM maintenance management teams can confirm operational difficulties or illuminate training issues. Similarly, operational unit training records may be utilized to confirm or deny training issues affecting maintenance and repair costs.

## **2. Databases**

As a part of ALREMP, ALRE data are forwarded to Naval Air Systems Command, Lakehurst and the appropriate TYCOM. Both organizations serve as central repositories for the storage and analysis of historical data on ALRE. The databases maintained by the TYCOMs and Naval Air Systems Command, Lakehurst are used to compare actual component failure rates with design performance criteria in order to identify any significant trends.

The various maintenance databases are a wealth of information regarding the execution of required preventive and corrective maintenance on ALRE. The core database at the organizational level is the Current Ship's Maintenance Project (CSMP). Deferment of all organizational level maintenance is documented in the ship's CSMP. As a scheduled maintenance period approaches, the TYCOM screens the CSMP job list

in preparation for the availability Work Definition Conference (WDC). At the WDC, the CSMP is divided into a Ship's Force Work Package (SFWP) and Availability Work Package (AWP). As the names suggest, the SFWP is to be completed by ship's crew during the availability while the AWP is assigned to the industrial facility. Upon a ship's completion of an availability, a Completed Work Package is issued by the industrial facility. These databases furnish a means of determining if operational maintenance is being deferred more often during contingency operations.

### **3. Interviews**

Personal interviews are an extremely important source of information for any research. The insight provided by those most intimately involved in an organization's operations is essential. All aspects of this research are supported by interviews with individuals whose day-to-day duties reflect a particular area of interest to this research. At the deck plates, maintenance chiefs, quality control personnel, catapult officers and maintenance officers have been contacted regarding the operation of a V-2 division aboard an aircraft carrier. Program managers at both Type Commands and the Program Office for ALRE (PMA 251) at NAVAIR Headquarters were consulted in the data collection process. Lastly, interviews with budgetary personnel in both the executive and legislative branches to include FMB, GAO, and NAVAIR were conducted. Their personal experiences were essential to wade through the litany of requirements set forth in various regulations and instructions regarding budgeting, programming, and accounting for contingency costs and ship maintenance costs.

### **III. DATA REDUCTION**

#### **A. VARIABLES AFFECTING MAINTENANCE AND REPAIR COSTS**

##### **1. Design**

The Naval Air Systems Command, Lakehurst is the lead technical organization for ALRE. The command is divided into various departments covering the full life cycle of ALRE components. The product development department of the Naval Air Systems Command, Lakehurst helps to derive the initial cost estimates for periodic maintenance of ALRE. Errors in initial estimates of maintenance and repair costs made during the design phase could manufacture an artificial increase in upkeep costs following product introduction. However, most ALRE systems have been in place for more than two decades. As a result, any life cycle cost inaccuracies during the product development stage have been superseded by the time of this data collection.

Over the life cycle of ALRE, the in-service engineering department of Naval Air Systems, Lakehurst promulgates changes in maintenance procedures and material composition of ALRE components through a multitude of technical directives and ship alterations. Most of these in-service changes are the result of new technologies or processes that have been approved for implementation following extensive cost/benefit analyses. The installation and implementation costs for these changes are tracked under the Service Change Installation Program (SCIP). The costs (particularly ship alterations) can be significant, but were not included in this analysis since such modernizations are unrelated to operational commitments. The funding for SCIP installations is through PMA 251 rather than the operational chain, and is therefore easily separated. [Ref. 19]



However, the maintenance and repair cost savings due to improved component performance and reduced maintenance requirements do have an impact on the data of this analysis. Since not all ships are fitted with equipment changes simultaneously, cost savings resulting from service changes commence at varying times. However, most service changes are implemented on all platforms within the course of a year. Furthermore, the savings afforded by SCIP installations are insignificant in comparison to the total maintenance and repair costs for any single platform over the course of a fiscal year. Since all data analysis spans at least a fiscal year, the effects of SCIP savings from platform to platform are small.

## **2. Operations**

### ***a. System Age***

Although intermediate and depot level maintenance are comprehensive, system age still has some bearing on ALRE maintenance and repair costs. Most major overhauls of ALRE incorporate reconditioned parts into the repairs. The Naval Aviation Depots (NADEP) and Voyage Repair Teams (VRT) maintain a rolling stock of major components to minimize the time necessary to accomplish major overhauls of ALRE components. Thus, no ALRE systems or even subsystems are fully outfitted with new components during depot level availabilities. Although the reconditioned equipment meets stringent specifications for reinstallation, its service life is unarguably less than that of a new component.

Perhaps of higher importance, ship age can result in higher maintenance and repair costs. Despite the best attempts to preserve ships' spaces, older ships tend to have more preservation problems throughout their spaces. When equipment operates in an increasingly adverse environment, failure rates and performance problems occur with

higher frequency. The higher incidence of corrective repairs on older ships translates into increased maintenance and repair costs.

***b. Level of Usage***

The level of usage is an obvious factor in the level of maintenance and repair required of ALRE. In fact, many of the organizational maintenance items are driven not by time, but by the number of catapult shots or recoveries. Even some of the periodic maintenance is derived from an assumed level of usage. Moreover, nearly all of the major maintenance items (echelon II and III) are scheduled according to level of usage based on historical failure rates. Since these more complex maintenance evolutions constitute a large fraction of the overall maintenance cost of ALRE components, usage and thus OPTEMPO are significant factors to consider in analyzing maintenance and repair costs.

***c. Preventive Maintenance Practices***

Proper preventive maintenance accomplishment is another significant factor for ALRE maintenance and repair costs. Improper preventive maintenance practices ultimately lead to premature component degradation and early overhaul or replacement of neglected components. One of the major tenets of the Maintenance and Material Management System (3M) and the Aircraft Launch and Recovery Equipment Management Program (ALREMP) is preventive maintenance supervision. Whether conducted organically by Collateral Duty Inspectors (CDI) and Quality Assurance (QA) personnel, or externally through inspection by Mobile Training Teams and the ALREMP Management Team, PMS oversight is central to minimizing equipment downtime and life cycle costs.

***d. Unit Material and Labor Costs***

Unit material and labor costs have a direct impact on ALRE maintenance and repair costs. Inflation pervades most industries. ALRE is no exception. Unit material and labor costs continue to rise at varying rates from year to year. The rise in unit material and labor costs is offset somewhat by initiatives through in-service changes designed to lower maintenance and repair costs. However, the gains made by SCIP pale in comparison to the overwhelming force of the ever-increasing "cost of doing business."

**B. VARIABLE SEPARATION**

**1. Training Usage**

Carrier Qualification (CQ) operations represent the formal training usage of ALRE. Pilots of carrier-borne aircraft must perform numerous carrier launches and landings in order to complete both initial qualification and refresher training. These CQ operations are normally scheduled during Tailored Ship's Training Availability (TSTA) IV or Independent Steaming Exercises (ISE). [Ref. 2, p.2] These operations represent a considerable spike in usage of ALRE.

The data from CQ operations are important for two distinct reasons. The primary use of the data is to develop an offset for training. When a carrier is engaged in extended overseas contingency operations, the carrier is not subject to supporting the Chief of Naval Air Training (CNATRA) for initial pilot qualification. Similarly, carriers in theater are not called upon to support proficiency training for Fleet Replacement Squadrons (FRS). Thus, training flight launches and recoveries are at a minimum when engaged in contingency operations.

Regardless of contingency operations, the requirement to conduct CQ operations in order to either qualify or maintain the proficiency of State-side pilots exists. Therein lies the second importance to the CQ operations data. The burden not borne by the carrier involved in a contingency must be assumed by a carrier in homeport. Therefore, increased ALRE usage by homeport carriers may hasten the requirement for a maintenance availability. The CQ operations data illuminate any imbalance in the burden-sharing of carriers with regard to carrier qualifications training.

## **2. Normal OPTEMPO Usage**

“Normal” OPTEMPO is a difficult parameter to derive, particularly in view of the expanding responsibilities of the U.S. military since the dissolution of the Soviet Union. The Cold War made for a relatively steady workload for the Armed Forces. For the past ten years, the number of missions assumed by U.S. forces has been anything but steady. Moreover, the force structure of the U.S. Armed Forces has changed dramatically since 1989. In a decade, the U.S. Navy has gone from a vision of six hundred ships to nearly half that number. “Doing more with less” has been the mantra for the better part of a decade.

The active aircraft carrier force dropped from 15 in 1990 to 12 in 2001 as the Forrestal class aircraft carriers were retired. Nevertheless, the number of carriers has not fluctuated much over the period of this study. In 1995, the number of active carriers dropped from 12 to 11, only to return to 12 once again in 2000. This small dip in carrier strength was actually administrative, not operational. The *USS Kennedy* (CV 67) was placed into the ranks of the reserves upon completion of its overhaul in 1995, but maintained an active OPTEMPO and was eventually restored to active duty. Agency

budget submissions and force planning documents provide an assumed “normal” OPTEMPO for the carrier fleet based upon underway days per quarter. Presently, the budget provides funds to achieve an OPTEMPO goal of 50.5 underway days per quarter for deployed forces and 28 underway days per quarter for non-deployed forces. [Ref. 4, p.2-3]

ALRE operations are not only affected by the ship’s schedule but also the requirements of the aircraft and aircrew. The number of active Navy carrier air wings has sharply declined from a Cold War strength of fifteen. Over the past five years, the number of Navy carrier air wings has steadied at ten, but the number of tactical aircraft and pilots has continued to decrease steadily. From FY1995 to FY1997, the active aircraft inventory dropped 3.7%. [Ref. 8, p.5] Aircraft force structure adjustments following the Quadrennial Defense Review (QDR) of 1997 further decreased the number of active aircraft by 2.8% between FY98 and FY00. [Ref. 6, p.2-9]

Aircraft OPTEMPO is governed by the Navy’s Flying Hour Program. The Flying Hour Program is funded to cover the cost to train and maintain qualified aircrews in the primary mission of their aircraft. Recent increases in maintenance costs attributed to aging aircraft and increasing repair parts prices have pushed the Department of the Navy’s goal for tactical air Primary Mission Readiness (PMR) from 83% to 81%. [Ref. 4, p.2-10]

### **3. Unit Material and Labor Costs**

Inflation indices for use in DoN budget formulation are promulgated by the Office of Budget (FMB). These indices have been used to adjust for increases in labor costs between fiscal years for ALRE intermediate and depot level maintenance. However, the

FMB indices for material costs were not used in the analysis because they were too generic. Both TYCOMs and Naval Air Systems Command, Lakehurst retain historical data on ALRE costs. These historical data are subdivided into material costs and labor costs. A specific material inflation index for ALRE was derived by comparing the price for identical ALRE components from year to year. A former Catapult and Arresting Gear Maintenance Officer at COMNAVAIRPAC, LT Gil Mucke, developed the material inflation index used in this study (see Appendix H). LT Mucke tracked ALRE cost data from FY95 to FY00 on organizational level maintenance material. Application of these two inflation indices served to estimate the increase in the "cost of doing business" due solely to inflation in maintenance and repair parts and labor.

### **C. GOAL OF VARIABLE SEPARATION**

The goal of defining and separating the variables impacting ALRE maintenance and repair costs is to isolate operational tempo. Contingency operations represent an unexpected and therefore unbudgeted increase in operational requirements. Without an established baseline of costs, arguments for incremental funding for contingency operations are a matter of interpretation. Establishing a universally accepted baseline of costs in terms of a small base of variables will aid in justifying supplemental funding requests for future contingency operations. Quantification of that baseline is the task at hand.

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## **IV. DATA ANALYSIS AND PRESENTATION**

### **A. REGRESSION ANALYSIS**

#### **1. Theory**

Regression analysis is a common means of determining the statistical relevance of one variable upon the behavior of a second variable. In financial analysis, this second variable, termed the dependent variable, is oftentimes cost or price. The first, or independent variable, is the subject of the analysis. In regression analysis, the independent variable(s) is mathematically tested as a predictor for the value of the dependent variable. Therefore, independent variables are commonly called explanatory variables. Simply put, financial regression analysis is a way to predict cost in terms of non-cost factors.

Regression analysis conducted with more than a single explanatory variable is termed multiple regression analysis. Using more than one explanatory variable typically allows for a more accurate estimation of cost. In multiple regression analysis, each independent variable is assigned responsibility for a portion of the variation in cost. Although this distribution of cost behavior among the explanatory variables allows for greater accuracy, inclusion of multiple variables in the analysis also introduces a greater possibility for violating the mathematical assumptions underlying the theory of regression analysis. Several tests have been developed to detect such violations and have been incorporated into the analysis.

This thesis employs regression analysis to determine a model to explain ALRE maintenance and repair costs in terms of non-cost factors. Chapter III described several



variables that would reasonably impact ALRE maintenance and repair costs. These variables are considered the independent variables and ALRE maintenance and repair cost is the dependent variable in this analysis.

## **B. BASELINE DETERMINATION**

### **1. "Normal" OPTEMPO**

The DoD Financial Management Regulation (DoDFMR, DoD 7000.14-R) defines incremental costs as those costs that are above and beyond baseline training, operations, and personnel costs. [Ref. 20, p.23-6] Baseline operations with respect to ALRE may be approached in a couple of different ways. As previously discussed, ALRE does not reside wholly within either NAVAIR or NAVSEA. The majority of funding for technical support and echelon II and III maintenance is provided through NAVAIR, yet major overhauls are funded through the Shipbuilding and Conversion, Navy (SCN) account. The V-2 Division Maintenance Officer must project the division's OPTAR (Operational Target) funding in order to comply with both NAVSEA's shipboard 3M system and NAVAIR's ALREMP. Thus, any baseline of operations derived solely from either wing or ship operations may fail to fully represent the "normal" OPTEMPO of V-2 division.

Since ALRE essentially serves two masters, the problem of establishing a baseline of operations was approached from both NAVAIR and NAVSEA perspectives. The Naval Air community utilizes the Flying Hour Program (FHP) and its accompanying metric, Primary Mission Readiness (PMR) percentage to track and justify funding for its flight operations. The U.S. Navy tactical air PMR goal for FY01 and FY02 is 81% (includes 2% simulator contribution). [Ref. 4, p.2-10] As recently as two years ago, the

tactical PMR goal was as high as 85% (includes 2% simulator contribution). [Ref. 6, p.2-11] However, recent increases in depot level repairable costs have driven up the cost per flying hour. Actual depot level repairable costs have been higher than budgeted every year since 1993 with the exception of 1995. Depot level repairable cost underestimations ranged from ten to twenty-eight per cent over this period. [Ref. 10, p.3] As a result, the number of flying hours (and consequently PMR) decreased in order to remain within budget.

The Naval Sea Systems community funds ship operations based upon underway days. For the last four years, the Navy's goal has stood at 50.5 underway days per quarter for deployed forces and 28 underway days per quarter for non-deployed forces. In FY97, the OPTEMPO provided under the budget was only slightly different at 50.5 underway days for deployed units and 27 underway days for non-deployed units. Over the past five years, deployed units have exceeded their OPTEMPO goal, while non-deployed units have fallen slightly short of the quarterly goal [Ref. 7, p.2-2]

Regression analysis was performed on the number of catapult shots with both PMR and underway days as explanatory variables, individually. The regression analysis showed mixed results – hardly surprising considering ALRE's unique blend of Naval Air and Sea operational ties. The regression with underway days was done using CY97 through CY00 data derived from the operational schedules of the carriers homeported on the east coast (see Appendix B). West coast carriers were not included because the AIRPAC operational data were not detailed enough to provide an accurate count of underway days. Regression showed a strong relationship between underway days and catapult shots for non-deployed units (see Figure 4.1), but a rather weak relationship for

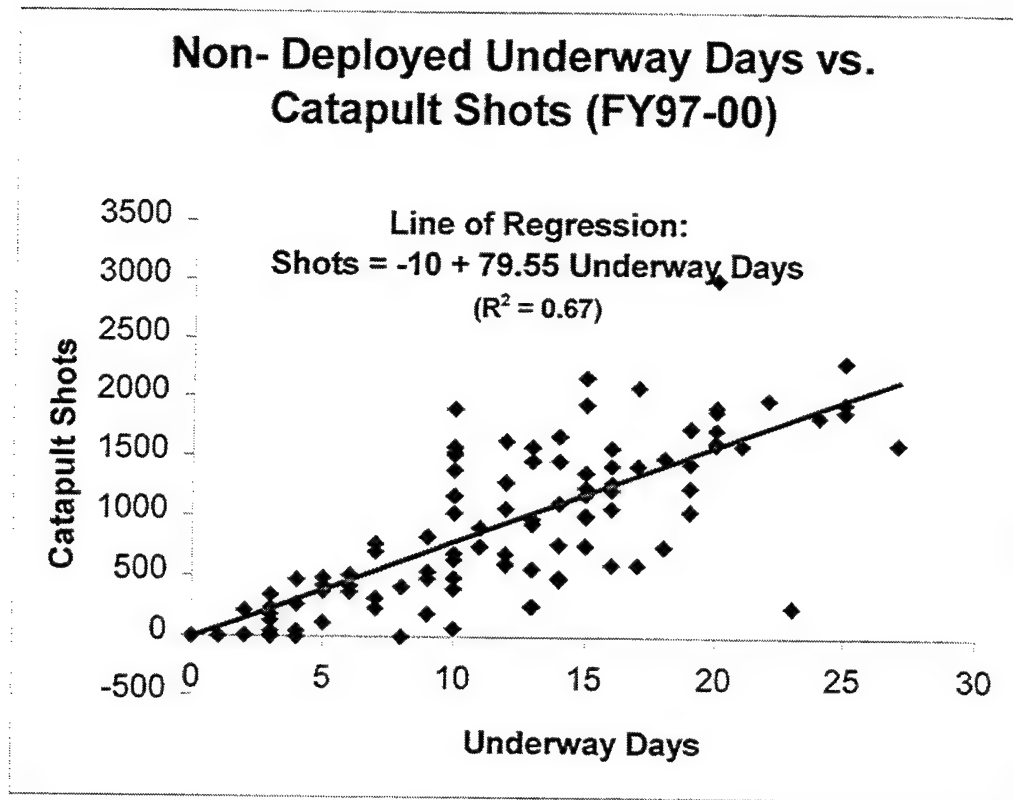


Figure 4.1 Non-Deployed Underway Days vs. Catapult Shots

deployed units (see Figure 4.2). Deployed underway days spent in transit (between CONUS and deployment area, Suez Canal, numerous ports of call) may explain the weak relationship for deployed units.

Regression using PMR was performed based upon monthly PMR percentages for Carrier Air Wings TWO, FIVE, NINE, ELEVEN, and FOURTEEN. The data provided by COMNAVAIRPAC spanned operations from FY97 to FY00 (see Appendix C). The results of the regression were a complete reversal from the underway day analysis. There was a strong tie between the number of catapult shots and PMR for deployed units (see Figure 4.3), yet no noteworthy relationship for non-deployed units (see Figure 4.4). The lack of a relationship between PMR and the number of catapult shots for non-deployed

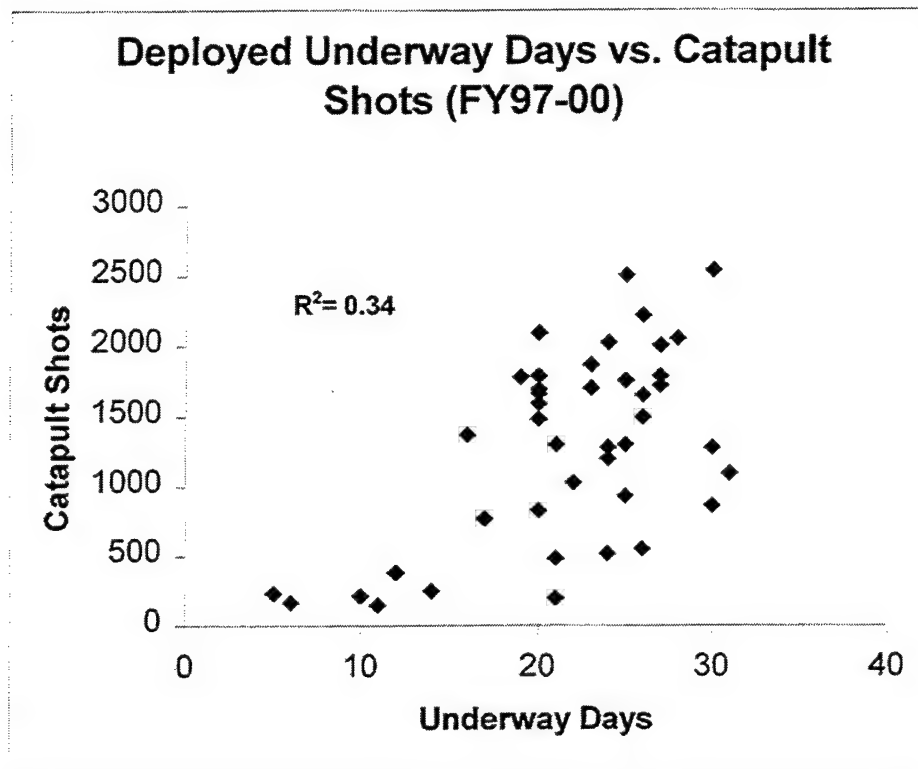


Figure 4.2 Deployed Underway Days vs. Catapult Shots

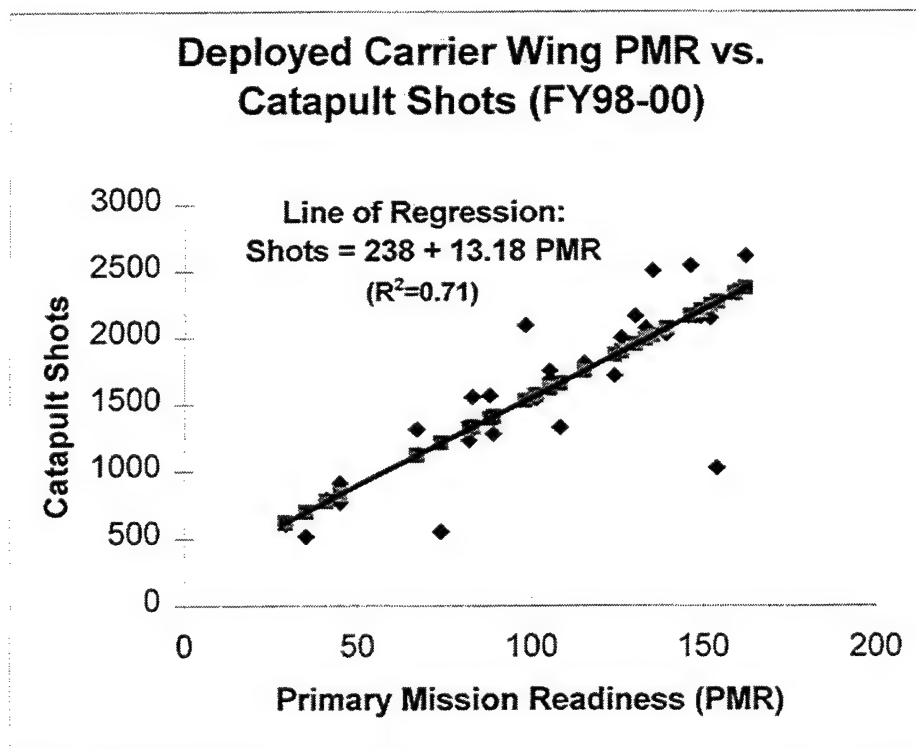


Figure 4.3 Deployed Carrier Wing PMR vs. Catapult Shots

units is not truly surprising given that the portion of PMR required to be performed aboard an aircraft carrier is relatively small.

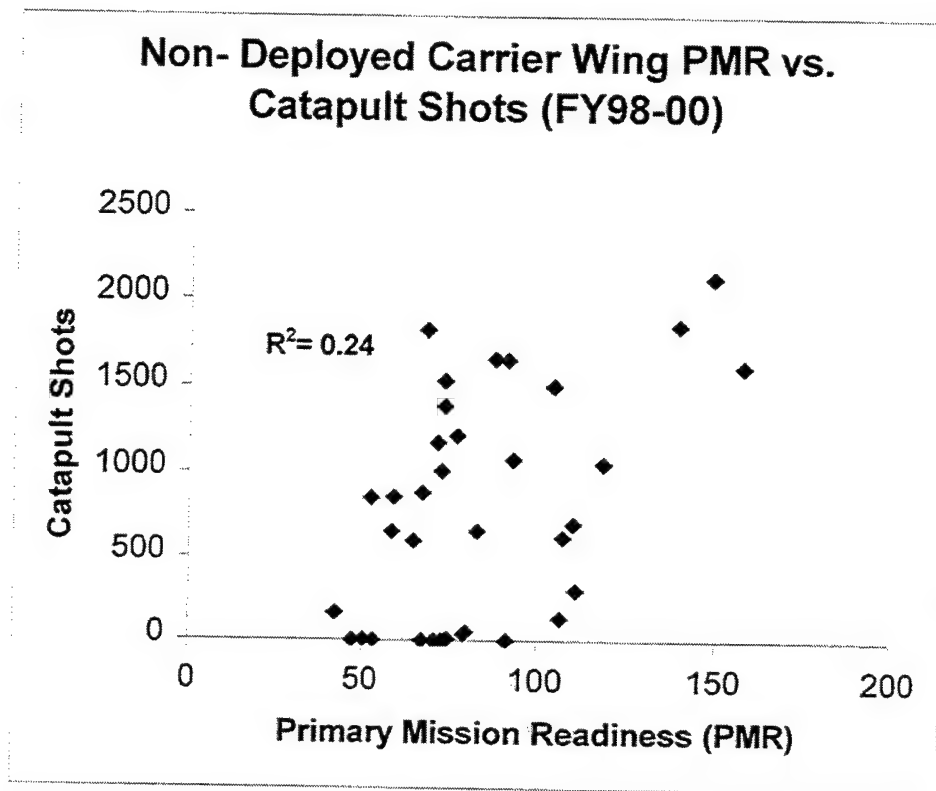


Figure 4.4 Non-Deployed Carrier Wing PMR vs. Catapult Shots

## 2. Training

ALRE supports the proficiency training of the Carrier Air Wings and the training of Fleet Replacement Squadrons (FRS). Separation of the two sets of requirements is often quite difficult. Ideally, the number of launches in support of the FRS should have been tabulated from Air Operations Summary Message Reports. According to COMNAVAIRPAC Instruction 3740.2W entitled, "Carrier Qualification (CQ) Operations," an Air Operations Summary Message Report must be sent to the appropriate TYCOM following each FRS CQ period. The report enumerates the number of pilots

qualified and the number of arrestments conducted during the CQ period. [Ref. 2, enclosure 5] Unfortunately, the TYCOMs do not maintain historical files of these reports. Therefore, historical data on carrier operations provided by the TYCOMs and the Automated Shot and Recovery Logs (ASRL) from Naval Air Systems Command, Lakehurst (Appendices D and E) were compared in order to estimate the number of launches made in support of training FRS. The AIRLANT data are less accurate than the AIRPAC data because AIRLANT routinely conducts carrier qualifications for its organic components concurrently with FRS carrier qualifications. AIRPAC does not typically mix the two training evolutions.

The training baseline for the operational units is embedded in the Navy's Flying Hour Program. The tactical PMR goal of 81% for FY01 and FY02 represents the level of funding allotted the carrier air wings to maintain pilot proficiency and train and equip the aircrews. Although the carrier qualification proficiency requirements for qualified pilots are less intensive than the initial carrier qualification requirements for FRS pilots, carrier air wing training requirements consume a major portion of the catapult shots for non-deployed units. However, as previously discussed, PMR does not accurately predict ALRE usage for non-deployed units. Since the bulk of carrier air wing training takes place in conjunction with fleet and carrier group exercises and PMR is not an effective metric for non-deployed units, the training baseline was subsumed within the operational tempo metrics.

## **C. DETERMINATION OF OPTEMPO INCREMENT**

### **1. Baseline Computation Example**

The operations and training baseline is computed using the two equations illustrated in Figures 4.1 and 4.3. The current non-deployed operational tempo is 9.3 underway days per month (28 days per quarter). For non-deployed units per the regression of Figure 4.1:

$$\# \text{ Catapult Shots/month} = -10 + 79.55 \text{ Underway Days/month}$$

Substituting 9.3 underway days per month into the equation yields 730 catapult shots per non-deployed unit month. Over the past three fiscal years, the Navy carrier fleet has averaged 74 non-deployed months per fiscal year. Multiplying 74 months and 730 catapult shots per month results in a fiscal year total of 54,020 non-deployed catapult shots.

Presently, average deployed PMR is estimated at 105% (see Appendix C). This figure includes sorties flown in support of contingencies. Contingency sorties accounted for 5% and 3% of the total tactical PMR achieved in FY 99 and FY00, respectively. [Ref. 11, p.7] Thus, the average baseline deployed PMR is approximately 101%. For deployed units per the regression of Figure 4.3:

$$\# \text{ Catapult Shots/month} = 238 + 13.18 \text{ PMR}$$

Substituting 101% into the equation yields 1569 catapult shots per deployed unit month. Over the past three fiscal years, the Navy carrier fleet has averaged 31 months on deployment. Multiplying 31 months and 1569 catapult shots per month results in a fiscal year total of 48,639 deployed catapult shots. Summing deployed and non-deployed catapult shots results in a baseline of 102,659 catapult shots per fiscal year. In FY00, the

carrier fleet executed 98,366 total catapult shots. During that year, the number of carrier fleet non-deployed and deployed months was lower than average at 72 and 28 months, respectively.

## **2. Incremental Calculation**

Using the goals established for the fiscal year in question, the baseline for ALRE training and operations may be calculated as above. Once this baseline has been set, any contingencies that exceed the baseline could justifiably be classified as incremental. In the case of FY00, the calculated baseline would have been 96,866 catapult shots. Since 98,366 catapult shots were executed in FY00, the increment for the fiscal year would have been 1500 catapult shots. During FY00, the carrier air wings aboard the *USS John F. Kennedy*, *USS Dwight D. Eisenhower*, *USS George Washington*, *USS Constellation*, and *USS John C. Stennis* flew well in excess of 1500 missions in support of Operations Northern and Southern Watch in the Arabian Gulf. Therefore, the 1500 catapult shots should be categorized as incremental due to contingency operations.

However, in Program Budget Decision 096 of December 2000, the Navy was denied funding for contingency flying hours in FY00 because the Flying Hour Program was underexecuted. The contingency sorties were applied to the Flying Hour Program shortfall and therefore were not considered incremental. [Ref. 11, p.7] Based upon this PBD finding, the baseline would be recalculated as follows: Recalculating catapult shots using the equation from Figure 4.3 and the full PMR of 105% yields a revised figure of 1622 catapult shots per deployed unit month. Multiplying 28 months and 1622 catapult shots per month results in a fiscal year total of 45,416 deployed catapult shots. Multiplying 72 non-deployed months and 730 catapult shots per month (per regression of



Figure 4.1) results in a fiscal year total of 52,560 non-deployed catapult shots. Summing deployed and non-deployed catapult shots results in a revised baseline of 97,976 catapult shots for FY00. The revised increment then decreases from 1500 to 390 catapult shots. Thus, even though the Navy was denied incremental funding for its Flying Hour Program due to contingencies, the equipment still bore a burden above its established baseline.

#### **D. INCREMENT COSTING**

Having established incremental usage of ALRE, an associated incremental cost may be determined. As outlined in Chapter 2, ALRE maintenance and repair costs are divided into organizational level and intermediate/depot level maintenance. The V-2 division personnel accomplish all of the organizational level maintenance. Therefore, only the material costs for organizational maintenance will be addressed. Intermediate and depot level maintenance is performed by the various Naval Aviation Depots (NADEPs), commercial contractors, commercial and navy shipyards, and Voyage Repair Teams (VRTs) with technical assistance from the Carrier and Field Service Units (CAFSUs) of Naval Air Systems Command, Lakehurst. Both material and labor costs are therefore pertinent to an analysis of ALRE intermediate/depot level maintenance.

##### **1. Operational Level Material Costs**

During the *USS Constellation's* 1998 Arabian Gulf deployment, a running tally was kept of all the material used in the accomplishment of maintenance and repair of ALRE. The data were tabulated by LT Gil Mucke of COMNAVAIRPAC and although the data compiled are too voluminous to list, a summary is presented in Appendix F. The resultant cost for organizational maintenance and repair was \$144 per catapult shot

(\$FY00). A study conducted by Naval Air Systems Command, Lakehurst, entitled "ALRE Cost of Ownership" (see Appendix G) was used as a check on this one-time figure. Based on FY99 costing data, the Naval Air Systems Command, Lakehurst study enumerated all costs associated with research and development, procurement, and operating and support costs for ALRE. The operational level dollar figures were based upon V-2 Division OPTAR expenditures and returned a cost of \$137 per catapult shot (\$FY99).

## **2. Intermediate/Depot Level Material and Labor Costs**

Intermediate and depot level cost data are spread among several different commands. The Ship Installation Offices at each TYCOM maintain program funds for upkeep and emergent repair of ALRE. These funds are set aside to support non-Chief of Naval Operations (CNO) availabilities such as Restricted Availabilities (RAVs) and inport upkeep periods. TYCOM funds for CNO availabilities such as Selected Restricted Availabilities (SRAs) and Planned Incremental Availabilities (PIAs) are tracked separately by the TYCOM budget department. Much of the work for CNO availabilities is performed by the shipyards in Norfolk, VA, Bremerton, WA and Yokosuka, Japan. Thus, Supervisor of Shipbuilding, Conversion, and Repair (SupShip) Code 1800 tracks many of the costs for the shipyard work. Lastly, the Navy Center for Cost Analyses also captures ALRE intermediate and depot level repair costs for their Visibility and Management of Maintenance and Operating Costs (VAMOSOC) database. However, none of these commands tracks all aspects of ALRE intermediate and depot level maintenance and repair costs.

From an overall cost standpoint, the TYCOMs are the most comprehensive source of information. Between the Ship Installation Office and the budget department, all ALRE costs are accounted for at an aggregate level. Table 4.1 lists upkeep and availability costs provided by each TYCOM for Fiscal Years (FY) 1997 through 2000. The costs listed in Table 4.1 are unadjusted for inflation. Inflation adjustments to the TYCOM data are reflected in Table 4.2. Adjustments were made using the material cost index of Appendix H and the price escalation indices listed in FMB's FY99 budget submission. Based upon ALRE historical data (FY97-00) provided by the Navy Center for Cost Analyses (see Appendices I and J), the assumed division between material and labor of 42/58 was made in applying the inflation indices. Using the cost data of Table 4.2, the average cost for echelon II and III maintenance and repair is \$262 per catapult shot.

		<b>FY97</b>	<b>FY98</b>	<b>FY99</b>	<b>FY00</b>
<b>AIRLANT</b>		(\$000)	(\$000)	(\$000)	(\$000)
	Upkeep	2972	2190	4410	3408
	Availabilities	5158	8914	8028	11305
	<b>TOTAL</b>	<b>8130</b>	<b>11104</b>	<b>12438</b>	<b>14713</b>
<b>AIRPAC</b>					
	Upkeep	5919	6849	7209	7215
	Availabilities	0	2196	3242	4519
	<b>TOTAL</b>	<b>5919</b>	<b>9045</b>	<b>10451</b>	<b>11734</b>
<b>TOTALS</b>					
	Upkeep Tot	8891	9039	11619	10623
	Avail Tot	5158	11110	11270	15824
	<b>Grand Total</b>	<b>14049</b>	<b>20149</b>	<b>22889</b>	<b>26447</b>

Table 4.1 TYCOM Upkeep and Availability Cost Data (Then Year Dollars)

		<b>FY97</b>	<b>FY98</b>	<b>FY99</b>	<b>FY00</b>
<b>AIRLANT</b>		(\$000)	(\$000)	(\$000)	(\$000)
	Upkeep	3876	2603	4795	3408
	Availabilities	6727	10596	8728	11305
	<b>TOTAL</b>	<b>10602</b>	<b>13199</b>	<b>13523</b>	<b>14713</b>
<b>AIRPAC</b>					
	Upkeep	7719	8141	7838	7215
	Availabilities	0	2610	3525	4519
	<b>TOTAL</b>	<b>7719</b>	<b>10752</b>	<b>11363</b>	<b>11734</b>
<b>TOTALS</b>					
	Upkeep Tot	11595	10744	12632	10623
	Avail Tot	6727	13206	12253	15824
	<b>Grand Total</b>	<b>18322</b>	<b>23951</b>	<b>24885</b>	<b>26447</b>

Table 4.2 TYCOM Upkeep and Availability Cost Data (FY00 Dollars)

To assign the full cost of intermediate and depot level maintenance and repairs on the basis of catapult shots ignores the factor of system age. In order to assess whether ship age is a significant factor in maintenance and repair costs, multiple regression was performed on the cost of upkeep and availabilities using the number of catapult shots and ship age as explanatory variables. The multiple regression model showed that the ship age had a negligible effect upon the costs to maintain ALRE. In fact, the regression model excluding ship age was statistically superior to the model including ship age.

The full cost of intermediate maintenance and repair cannot be reasonably assessed solely on the basis of catapult shots. There are depot-level maintenance items such as work on the catapult trough covers and the catapult steam system that are driven more by time than usage level. Upkeep and emergent repairs are reasonably attributed wholly to catapult shots since the work is closely tied to recent operations. Upkeep represents 45% of the total echelon II and III maintenance and repair costs (see Table

4.2). Therefore, \$118 of the \$262 may be reasonably assigned on the basis of catapult shots.

In order to account for availability work not tied to catapult and arresting gear usage, a listing of ALRE work done by availability was obtained from SupShip Code 1800 in Newport, News, VA. The SupShip cost report listed all availability work items by Extended Ship Work Breakdown Structure (ESWBS) code. All line items for codes pertaining to jet blast deflectors, aircraft elevators and elevator doors, aircraft/helicopter handling and support facilities and the catapult steam system were deleted from consideration. The resultant aggregate costs are shown in Table 4.3. Based on this modified costing model, the availability cost for ALRE is \$60 per catapult shot. When combined with the upkeep costs, the modified average echelon II and III maintenance and repair figure is \$178 per catapult shot.

		<b>FY97</b>	<b>FY98</b>	<b>FY99</b>	<b>FY00</b>
		(\$000)	(\$000)	(\$000)	(\$000)
<b>AIRLANT</b>					
	Upkeep	3876	2603	4795	3408
	Availabilities	786	3358	3315	6470
	<b>TOTAL</b>	<b>4662</b>	<b>5961</b>	<b>8110</b>	<b>9878</b>
<b>AIRPAC</b>					
	Upkeep	7719	8141	7838	7215
	Availabilities	0	966	1304	1672
	<b>TOTAL</b>	<b>7719</b>	<b>9107</b>	<b>9142</b>	<b>8887</b>
<b>TOTALS</b>					
	Upkeep Tot	11595	10744	12632	10623
	Avail Tot	786	4324	4619	8142
	<b>Grand Total</b>	<b>12381</b>	<b>15068</b>	<b>17252</b>	<b>18765</b>

Table 4.3 TYCOM/SupShip Modified Upkeep and Availability Cost Data (FY00 Dollars)

## **E. CONTINGENCY EXAMPLE**

Reconstitution of ALRE would be estimated in the following fashion for a contingency with a predicted 3000 sorties assuming the baseline operational tempo and training levels were met for the fiscal year:

### **Operational Level Material:**

3000 shots X \$144 = \$ 432,000

### **Intermediate/Depot Maintenance and Repair –Upkeep:**

3000 shots X \$118 = \$ 354,000

### **Intermediate/Depot Maintenance and Repair –Availabilities:**

3000 shots X \$ 60 = \$ 180,000

**Total Reconstitution Cost: \$ 966,000**

The Total Reconstitution Cost figure represents the additional burden borne by ALRE as a direct result of the contingency operation. The operational level material and upkeep portions of the total cost are near term costs that the service would expend within a year of the actual operation. The availability portion of the total cost (19%) would not become a burden until the next scheduled availability (up to two years later). In Chapter V, the implications of the incremental costs calculated above are summarized and discussed.

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## **V. CONCLUSIONS AND RECOMMENDATIONS**

### **A. SUMMARY**

Contingency operations have become common evolutions for the U.S. military over the past decade. Since the conclusion of the Cold War, the United States Armed Forces have participated in over one hundred Operations Other Than War (OOTW), ranging from humanitarian assistance and disaster recovery operations to peacekeeping and peace enforcement. [Ref. 14, pp.91-100] Most of these engagements occurred in response to a crisis and therefore were not included in the defense agencies' budgets. In order to cover contingency costs, DoD activities routinely transferred or reprogrammed funds from within their existing budgets. The service components were subsequently reimbursed through supplemental appropriations, but frequently readiness was affected while awaiting reimbursement. The establishment of the Overseas Contingency Operations Transfer Fund (OCOTF) has mitigated the fiscal impact of contingency operations on the services, but supplemental appropriations have still been necessary to reimburse the services for contingency-related expenditures.

Contingency reconstitution costs, the costs to maintain, replace, and restore equipment to a fully operational condition at the conclusion of a contingency, have not been fully captured by the services in their requests for reimbursement. The Navy has recovered some reconstitution costs in the maintenance and repair of aircraft and ground combat equipment, but has not actively sought reimbursement for its fleet of ships. This thesis forges the extension of reconstitution cost recovery to shipboard systems.



## **B. CONCLUSIONS**

This thesis presents a defensible method for calculating incremental maintenance and repair costs for Aircraft Launch and Recovery Equipment (ALRE) associated with contingency operations. The DoD Financial Management Regulation clearly stipulates that costs must exceed a baseline of operations and training in order to be considered incremental. This thesis establishes a baseline of operations and training using regression analysis.

The explanatory variables used in the regression analysis are the universally accepted metrics of underway steaming days and Primary Mission Readiness (PMR). The dependent variable in the analysis is the number of catapult shots. The number of catapult shots was selected due to its direct link with maintenance and repair costs. The grand majority of maintenance and repair performed on ALRE is based upon the number of catapult shots or arrestments made using the equipment. Historical data on maintenance and repair costs were then applied to the number of catapult shots recorded between FY97 and FY00. The result is a maintenance and repair cost breakdown per catapult shot in organizational level material, and intermediate and depot level material and labor.

In total, each catapult shot costs approximately \$322 (\$FY00) in maintenance and repair to ALRE. Using this cost figure, the Navy may predict future costs of ALRE based on an assumed tempo of operations and training. More importantly, the Navy may use the figures in this thesis to justify requests for reimbursement of ALRE reconstitution costs due to contingency operations.

## **C. RECOMMENDATIONS**

### **1. Application to Other Shipboard Systems**

It is the hope of this author that this thesis may serve as a model for similar studies of other shipboard systems. Although the dependent variable of catapult shots is ALRE-specific, the process of establishing a baseline through underway days and PMR is not. Application of another dependent variable, such as Effective Full Power Hours (EFPH) in the case of nuclear fuel expenses, may result in similar findings for the recovery of contingency reconstitution costs for the engineering department of a nuclear-propelled carrier.

### **2. Incremental Cost Justification**

OMB and OSD contend that contingency flight hours should be applied to PMR shortfalls instead of being categorized as incremental. The Navy contends that contingency flying hours cannot be substituted for budgeted FHP hours because they are not equivalent. The Navy's stance is supported by this thesis. As demonstrated in the calculations and discussion under the heading, "Incremental Calculation" in Chapter IV (pp. 35-36), ALRE still bore a burden above its established baseline even if the sorties were not considered to be incremental. It is therefore likely that the Navy's contention that contingency flying hours and budgeted FHP hours are not interchangeable is well-founded. From the standpoint of the V-2 Division personnel, non-deployed PMR and deployed PMR are not equivalent, as the aircraft carrier's PMR burden while deployed is much higher. Further research into the relationship of PMR and aircraft carrier operations may lead to a quantifiable answer to this debate.

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## APPENDIX A. LIST OF ACRONYMS

3M	Maintenance and Material Management System
AIMD	Aviation Intermediate Maintenance Department
ALRE	Aircraft Launch and Recovery Equipment
ALREMP	Aircraft Launch and Recovery Equipment Management Program
ASRL	Automated Shot and Recovery Log
AWP	Availability Work Package
BEA	Budget Enforcement Act of 1990
BES	Budget Estimate Submissions
CAFSU	Carrier And Field Service Unit
CASREP	Casualty Report
CDI	Collateral Duty Inspectors
CNO	Chief of Naval Operations
COMNAVAIRLANT	Commander, Naval Air Forces, Atlantic
COMNAVAIRPAC	Commander, Naval Air Forces, Pacific
CRS	Congressional Research Service
CSMP	Current Ship's Maintenance Project
DBOF	Defense Business Operations Fund

DoDFMR	Department of Defense Financial Management Regulation
EFPH	Effective Full Power Hours
ESWBS	Extended Ship Work Breakdown Structure
FHP	Flying Hour Program
FMB	Office of Budget (Navy)
FRS	Fleet Replacement Squadrons
FYDP	Future Years Defense Plan
GAO	General Accounting Office
GCI	Global Cooperative Initiatives Account
ISE	Independent Steaming Exercises
ISIC	Immediate Superior In the Chain of Command
NADEP	Naval Aviation Depot
NAVAIR	Naval Air Systems Command
O&M	Operations and Maintenance
OCOTF	Overseas Contingency Operations Transfer Fund
OMB	Office of Management and Budget
OMMS	Organizational Maintenance Management System
OOTW	Operations Other Than War

OPTEMPO	Operations Tempo
QDR	Quadrennial Defense Review
PBD	Program Budget Decision
PDD	Presidential Decision Directive
PMA251	ALRE Program Management Office
PMR	Primary Mission Readiness
PMS	Planned Maintenance System
QA	Quality Assurance
RAV	Restricted Availability
RPA	Readiness Preservation Authority
SCIP	Service Change Installation Program
SFWP	Ship's Force Work Package
SIMA	Ship's Intermediate Maintenance Activity
SRA	Selected Restricted Availability
SupShip	Supervisor of Shipbuilding, Conversion and Repair
TSTA	Tailored Ship's Training Availability
TYCOM	Type Commander
VAMOSC	Visibility and Management of Operating and Support Costs

VRT

Voyage Repair Team

WDC

Work Definition Conference

## APPENDIX B. AIRCRAFT CARRIER UNDERWAY DAYS

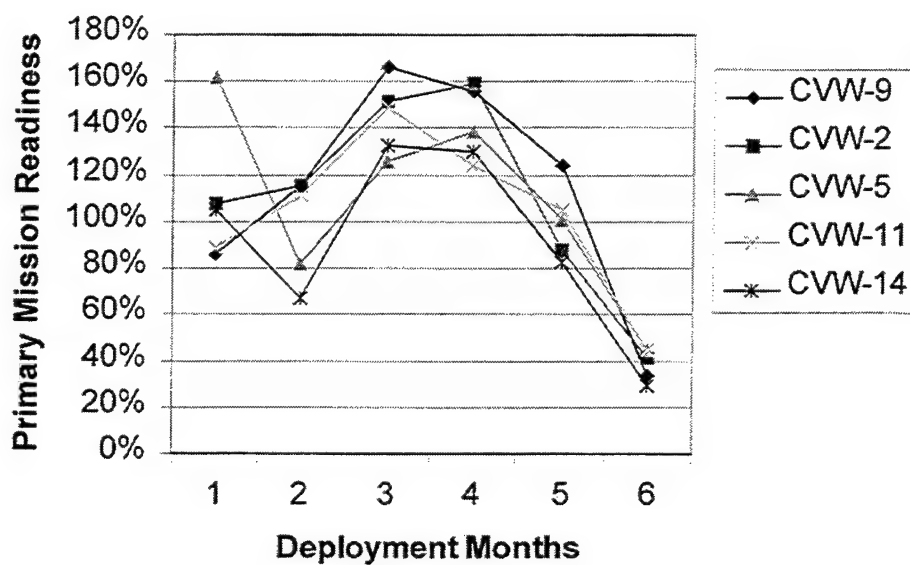
<b>CY 97</b>	<b>Jan</b>	<b>Feb</b>	<b>March</b>	<b>April</b>	<b>May</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>Sept</b>	<b>Oct</b>	<b>Nov</b>	<b>Dec</b>
CVN 65	3	0	0	0	0	0	0	9	17	14	0	13
CV 67	0	10	18	2	25	19	16	20	25	23	0	5
CVN 69	3	4	13	13	8	11	12	13	15	0	16	13
CVN 71	17	20	24	25	11	0	0	0	0	0	0	0
CVN 73	0	0	15	11	20	25	0	14	4	28	20	27
CVN 74	15	0	12	7	7	12	8	17	0	14	20	0
<b>CY98</b>												
CVN 65	10	9	15	15	3	10	16	21	12	5	24	27
CV 67	0	0	0	10	17	7	14	20	10	10	0	10
CVN 69	3	19	5	4	6	20	20	19	20	27	25	10
CVN 71	0	0	0	0	0	0	7	9	12	14	19	18
CVN 73	26	26	21	3	0	0	0	0	0	0	0	0
CVN 74	19	6	26	25	20	30	22	24	0	0	0	0
<b>CY99</b>												
CVN 65	16	23	23	30	6	0	0	0	0	0	0	0
CV 67	6	0	10	20	0	20	22	0	12	26	21	24
CVN 69	0	0	0	0	0	12	16	13	10	24	0	15
CVN 71	0	27	5	30	25	20	21	31	14	0	4	0
CVN 73	0	0	10	1	10	10	2	15	10	16	3	6
CVN 75	5	3	15	0	0	0	0	6	14	9	3	12
<b>CY00</b>												
CVN 65	3	10	13	8	11	16	13	10	12	7	8	6
CV 67	23	19	14	3	13	6	11	0	0	0	0	12
CVN 69	8	11	25	17	21	21	26	11	0	0	11	11
CVN 71	0	0	0	0	0	0	19	3	13	12	6	7
CVN 73	6	7	28	7	14	9	27	21	30	24	16	15
CVN 75	5	10	13	4	17	10	6	24	0	15	3	26



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## APPENDIX C. CVW DEPLOYED PMR EXECUTION

### CVW Deployed Primary Mission Readiness (FY98-00)



	Deployment Months						
	1	2	3	4	5	6	Average
CVW-9	86%	115%	166%	156%	124%	34%	113.5%
CVW-2	108%	115%	152%	159%	88%	41%	110.5%
CVW-5	162%	82%	126%	139%	101%	45%	109.2%
CVW-11	89%	111%	149%	124%	105%	45%	103.8%
CVW-14	105%	67%	133%	130%	83%	29%	91.2%
Average	110.0%	98.0%	145.2%	141.6%	100.2%	38.8%	105.6%

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# **APPENDIX D. AUTOMATED SHOT AND RECOVERY LOG (FY98)**

## **CY 97**

DATE	62	63	64	65	67	68	69	70	71	72	73	74	75
JANUARY	307	1,789	1,099	133	NOFO	102	43	79	772	46	SRA	2,164	
FEB	968	1,383	1,307	NOFO	687	2,307	44	NOFO	1,666	127	91	NOFO	
MARCH	1,121	774	NOFO	NOFO	1,486	NOFO	1,574	NOFO	2,027	1,803	1,007	1,063	
APRIL	1,006	267	1,448	NOFO	216	1,492	935	NOFO	1,755	NOFO	748	704	
MAY	1,277	NOFO	1,765	NOFO	1,947	1,377	414	NOFO	150	920	3,000	320	
JUNE	571	NOFO	1,612	NOFO	1,437	970	901	NOFO	NOFO	1,012	1,880	600	
JULY	5	NOFO	2,060	NOFO	1,217	2,008	1,626	NOFO	NOFO	1,531	NOFO	NOFO	
AUGUST	393	NOFO	1,620	538	1,600	NOFO	974	NOFO	NOFO	38	1,667	1,419	123
SEPT	1,396	NOFO	788	600	2,299	300	998	517	NOFO	1,388	270	NOFO	
OCT	942	NOFO	NOFO	1,460	250	1,736	NOFO	8	NOFO	853	2,056	1,108	110
NOV	813	NOFO	701	NOFO	NOFO	1,443	1,419	703	NOFO	623	1,595	1,912	90
DEC	BD	NOFO	453	1,460	114	1,914	563	340	NOFO	1,653	1,720	NOFO	
<b>TOTAL</b>	<b>8,799</b>	<b>4,213</b>	<b>12,853</b>	<b>4,191</b>	<b>11,253</b>	<b>13,649</b>	<b>9,491</b>	<b>1,647</b>	<b>6,370</b>	<b>9,994</b>	<b>14,034</b>	<b>9,290</b>	<b>323</b>

## **CY 98**

DATE	62	63	64	65	67	68	69	70	71	72	73	74	75
JANUARY	611	103	NOFO	1,380	NOFO	2,076	347	439	NOFO	NOFO	1,653	1,042	106
FEB	1,815	NOFO	NOFO	190	NOFO	250	1,737	557	NOFO	657	1,498	NOFO	
MARCH	1,598	NOFO	NOFO	1,936	16	NOFO	427	2,443	NOFO	1,081	484	552	
APRIL	1,450	278	NOFO	1,182	67	NOFO	472	359	232	1,852	112	2,505	
MAY	937	1,285	NOFO	NOFO	2,080	NOFO	512	767	463	5	40	2,094	
JUNE	109	280	NOFO	1,892	769	RCOH	1,485	549	10	1,754	NOFO	2,543	34
JULY		925	NOFO	1,568	769	RCOH	1,789	2,338	236	1,317	NOFO	1,028	
AUGUST		377	52	1,592	1,620	RCOH	1,782	382	483	2,077	NOFO	517	700
SEPT		NOFO	1,506	1,283	1,022	RCOH	1,696	NOFO	611	2,165	NOFO	NOFO	754
OCT		2,340	860	379	1,566	RCOH	2,007	NOFO	492	1,559	NOFO	NOFO	175
NOV		906	1,822	1,279	NOFO	RCOH	1,300	1,283	1,236	608	NOFO	NOFO	1,219
DEC		NOFO	702	1,788	1,528	RCOH	213	250	752	250	NOFO	NOFO	1,082
<b>TOTAL</b>	<b>6,520</b>	<b>6,494</b>	<b>4,942</b>	<b>14,469</b>	<b>9,437</b>	<b>2,326</b>	<b>13,767</b>	<b>9,367</b>	<b>4,515</b>	<b>13,325</b>	<b>3,787</b>	<b>10,281</b>	<b>4,070</b>

<b>FY 1998</b>	<b>3248</b>	<b>2712</b>	<b>13943</b>	<b>6707</b>	<b>7419</b>	<b>12229</b>	<b>8885</b>	<b>2035</b>	<b>14037</b>	<b>9158</b>	<b>13301</b>	<b>1794</b>
RED	0	0	0	250	7,419	6752	0	0	7313	9118	9239	0
BLUE	0	2207	2920	0	0	0	1324	0	657	0	0	0
GREEN	0	0	3316	4722	0	0	0	0	0	0	0	0
PURPLE	3145	453	7707	1538	0	5477	7561	2035	6067	40	4062	1454

## **LEGEND**

RED Gulf Deploy  
 BLUE FRS/TRA CQ  
 GREEN FRS CQ/ Exercises  
 PURPLE Exs/ISE  
 = Estimated Value

TOTAL	CNAP	CNAL
95468	49602	45866
40091	23971	16120
7108	4188	2920
8038	0	8038
39539	21288	18251

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# **APPENDIX E. AUTOMATED SHOT AND RECOVERY LOG** **(FY99-00)**

## **CY 99**

DATE	63	64	65-Q	67	68	69	70	71	72	73	74	75
JANUARY	324	304	1,373	372	COH	NOFO	2,160	NOFO	1,010	NOFO	NOFO	486
FEB	NOFO	1,216	1,867	NOFO	COH	NOFO	1,718	1,605	NOFO	50	NOFO	240
MARCH	2,615	1,058	1,703	1,570	COH	NOFO	1,692	233	1,193	399	9	761
APRIL	1,236	598	1,277	1,878	COH	NOFO	915	863	NOFO	NOFO	1,177	NOFO
MAY	2,001	1,334	166	NOFO	COH	29	124	932	NOFO	1,165	134	NOFO
JUNE	2,032	1,186	9	1,718	COH	689	NOFO	829	NOFO	1,509	884	NOFO
JULY	1,546	1,331	NOFO	1,978	COH	1,067	600	199	NOFO	7	658	NOFO
AUGUST	770	1,813	NOFO	NOFO	COH	255	18	1,094	NOFO	1,236	2,128	421
SEPT	NOFO	2,150	NOFO	384	COH	640	600	251	352	488	600	479
OCT	1,140	2,350	NOFO	2,218	COH	1,834	NOFO	NOFO	196	599	1,660	829
NOV	874	1,568	NOFO	1,302	COH	NOFO	NOFO	NOFO	1,735	9	1,616	183
DEC	NOFO	792	54	1,200	COH	1,361	NOFO	NOFO	NOFO	1,273	165	1,274
<b>TOTAL</b>	<b>12,538</b>	<b>15,700</b>	<b>6,449</b>	<b>12,620</b>	<b>0</b>	<b>5,875</b>	<b>7,827</b>	<b>6,006</b>	<b>4,486</b>	<b>6,735</b>	<b>9,031</b>	<b>4,673</b>

## **CY 00**

DATE	63	64	65-Q	67	68	69	70	71	72	73	74	75
JANUARY	NOFO	236	14	2,465	COH	317	NOFO	NOFO	1,313	428	1,256	246
FEB	817	956	754	1,620	COH	606	NOFO	NOFO	856	260	1,628	842
MARCH	357	NOFO	854	382	COH	2,106	NOFO	NOFO	218	2,920	2,602	914
APRIL	1,397	4	563	NOFO	COH	1,345	NOFO	NOFO	1,846	447	2,689	12
MAY	1,691	543	1,631	782	COH	1,342	NOFO	NOFO	1,125	1,357	2,048	1,336
JUNE	334	915	899	166	COH	1,948	NOFO	9	1,645	581	684	644
JULY	NOFO	928	23	1,500	COH	1,620	NOFO	NOFO	1,250	1,742	NOFO	610
AUGUST	NOFO	252	948	NOFO	COH	225	88	1	957	1,600	NOFO	2,059
SEPT	680	838	1,309	NOFO	COH	NOFO	146	948	1,618	1,832	NOFO	10
OCT	2,333	2,165	215	NOFO	COH	NOFO	558	ND	1,843	2,412	NOFO	1,267
NOV	947	749	735	NOFO	COH	341	1,018	ND	1,953	1,250	NOFO	318
DEC	NOFO	1,739	443	NOFO	COH	1,111	ND	ND	1,850	484	NOFO	1,246
<b>TOTAL</b>	<b>8,556</b>	<b>9,325</b>	<b>8,388</b>	<b>6,915</b>	<b>0</b>	<b>10,961</b>	<b>1,810</b>	<b>958</b>	<b>16,474</b>	<b>15,313</b>	<b>10,907</b>	<b>9,504</b>

<b>FY 1999</b>	<b>13770</b>	<b>14374</b>	<b>9841</b>	<b>10994</b>	<b>RCOH</b>	<b>6200</b>	<b>9360</b>	<b>8486</b>	<b>4972</b>	<b>4854</b>	<b>5590</b>	<b>4863</b>
RED	10200	6480	9453	384	0	3520	8142	4401	2417	0	0	0
BLUE	0	1300	0	3466	0	0	1218	0	2203	3169	2661	486
GREEN	0	860	0	0	0	0	0	0	0	1236	0	0
PURPLE	3570	5734	388	7144	0	2651	0	4085	352	449	2920	4377
<b>FY 2000</b>	<b>7,290</b>	<b>9382</b>	<b>7049</b>	<b>11635</b>	<b>RCOH</b>	<b>12704</b>	<b>234</b>	<b>958</b>	<b>12759</b>	<b>13048</b>	<b>14348</b>	<b>8959</b>
RED	0	4710	0	9187	0	9192	0	0	2575	5755	10907	0
BLUE	0	3873	0	0	0	0	0	0	218	688	3441	183
GREEN	0	0	4332	0	0	0	0	948	1846	599	0	4749
PURPLE	7290	795	2717	2448	0	3512	234	10	8120	6006	0	4027

## **LEGEND**

RED Gulf Deploy  
 BLUE FRS/TRA CQ  
 GREEN FRS CQ/ Exercises  
 PURPLE Exs/ISE  
 = Estimated Value

FY99	TOTAL	CNAP	CNAL
	93304	48066	45238
	44997	27239	17758
	14503	7382	7121
	2096	860	1236
	31670	12576	19094

FY00	TOTAL	CNAP	CNAL
	98366	44013	54353
	42326	18192	24134
	8403	7532	871
	12474	1846	10628
	35159	16439	18720

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## APPENDIX F. ORGANIZATIONAL LEVEL MATERIAL COSTS

Column 1	Column 2	Column 3	Column 4
O =	\$1,061,003.69	100%	\$1,061,003.69
P =	\$130,945.82	100%	\$130,945.82
C =	\$169,070.32	100%	\$169,070.32
W =	\$77,528.79	100%	\$77,528.79
		TOTAL =	\$1,438,548.62

PERIODICITY - DAYS: 180  
 SORTIE COUNT: 10,000

SORTIE COST: \$143.85  
 Cost Per Sortie - Contains average: Total cost / sortie

### Calculations:

**Column 1** - Contains group category from notes above.  
**Column 2** - Contains Sub-totals from each worksheet.  
**Column 3** - Contains formula in notes above for computing annual funding requirements. Adjustments can be made off of sortie counts based on ship's op schedule.  
**Column 4** - Contains calculation totals

### Notes:

**O** - Contains all items that are driven by an operational count even if utilized during a maintenance evolution. (10,000 Sorties)  
**P** - Contains all items that are PMS driven other than "R" check items driven by operational counts. (6 months of PMS)  
**C** - Contains all corrective maintenance items including repairs and replacements of tools used to perform maintenance. (6 months corrective and approx 66% annual cost)  
**W** - Contains items that either affect crew health and welfare, or are required for administrative support/cleanliness. (6 months administrative and approx 66% annual cost)



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## APPENDIX G. ALRE COST OF OWNERSHIP

		ALRE COST OF OWNERSHIP			ALRE O&S Costs per CVN per year		
		O&M,N FUNDS	MILPERS FUNDS				
		PER	OPTAR FUNDS	PERSONNEL			
		SHIP	MAINTENANCE	OPS + MAINT			
		Cost	Number of	Cost	Lakehurst Cost Model		
		\$	Personnel	@ 62,000/manyr			
					Launch	Recover	
<b>AIRLANT</b>							
	Tycom OPTAR Funds	10,972,582			Depot Level	1,007,562	621,22
	Other Ship Maint Funds						
<b>CVS</b>					O Level		
	No of CV's	6			Mat'l	661,143	407,63
	OPTAR Funds/CV	1,200,000	7,200,000		V-2 Pers'l	141	6
	V-2 Div Personell/CV	241		1,446	V-2 Pers'l \$	8,742,000	4,278,00
					Total	10,410,705	5,306,85
<b>AIRPAC</b>							
	Tycom OPTAR Funds	12,000,000					
	Other Ship Maint Funds						
<b>CVS</b>							
	No of CV's	6					
	OPTAR Funds/CV	1,500,000	9,000,000				
	V-2 Div Personell/CV	241		1,446	89,652,000		
<b>FY99 ALRE COST OF OWNERSHIP</b>							
		PMA251		TYCOM			
				& FLEET	SUM		
		\$M		\$M	\$M		
ACTN	RDT&E	12.3			12.3		
ACTN	PROCUREMENT	42.5	12.9		55.4		
O&S	O&M,N	26.5		63.7	90.2		
O&S	MILPERS	-		228.9	228.9		
		81.3	12.9	292.6	386.8		
		ALRE ACQUISITION COST			67.7		
		ALRE OPS & SUPPORT COST			319.1		
		ALRE COST OF OWNERSHIP			386.8		

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## APPENDIX H. MATERIAL INFLATION INDEX

### ALRE COST OF DOING BUSINESS

Per 10K Sorties

Nomenclature	NSN	1995 Cost	2000 Cost	Avg Use	Avg Cost (1995)	Avg Cost (2000)
Catapult Cables	1710-01-292-9873	\$1,800.00	\$1,617.66	8	\$14,400.00	\$12,941.28
Shuttle Assy	1720-01-158-1698	\$34,641.00	\$59,000.00	2	\$69,282.00	\$118,000.00
S-3 Holdback	1720-01-022-6299	\$965.00	\$1,943.00	6	\$5,790.00	\$11,658.00
S-3 T-bar	1720-00-492-0806	\$41.52	\$64.19	1320	\$54,806.40	\$84,730.80
A-6 Holdback	1720-01-064-6070	\$999.91	\$1,352.92	8	\$7,999.28	\$10,823.36
A-6 T-bar	1720-00-869-5453	\$8.50	\$18.78	1320	\$11,220.00	\$24,789.60
RRRB F-14	1730-01-250-2685	\$4,930.00	\$8,350.00	18	\$88,740.00	\$150,300.00
RRRB F-18	1720-01-163-6062	\$3,364.00	\$4,880.00	14	\$47,096.00	\$68,320.00
Cat Lube Oil	9150-00-753-4937	\$207.25	\$165.00	240	\$49,740.00	\$39,600.00
Purchase Cable	1710-00-102-7796	\$2,467.00	\$9,125.00	8	\$19,736.00	\$73,000.00
CDP (110')	1710-00-050-8872	\$2,467.00	\$8,700.00	75	\$185,025.00	\$652,500.00
Wire Support	1710-00-626-3917	\$90.00	\$162.50	200	\$18,000.00	\$32,500.00
Piston (Mod0/1)	1720-00-111-5527	\$1,085.00	\$2,617.41	4	\$4,340.00	\$10,469.64
Guide (Mod0/1)	1720-00-939-0113	\$1,733.00	\$1,733.00	4	\$6,932.00	\$6,932.00
Connector (L)	1720-00-130-7453	\$5,757.00	\$7,305.87	4	\$23,028.00	\$29,223.48
Connector (R)	1720-00-130-7454	\$5,543.00	\$7,104.17	4	\$22,172.00	\$28,416.68
Choke Ring	1720-00-476-0009	\$600.00	\$1,273.00	6	\$3,600.00	\$7,638.00
Barrel Nuts	5310-01-322-8047	\$35.00	\$105.31	350	\$12,250.00	\$36,858.50
Ret. Bar Bolts	5306-01-420-7844	\$8.00	\$34.74	250	\$2,000.00	\$8,685.00
H-block Bolts	5306-01-275-4002	\$5.00	\$14.07	100	\$500.00	\$1,407.00
<b>Total:</b>					<b>\$646,656.68</b>	<b>\$1,408,793.34</b>

Cost increase for 10k sorties: \$762,137  
 Per sortie increase: \$76.21

% Increase = 117.86%  
 IRR = 16.9%

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# APPENDIX I.

# VAMOSC ALRE COST DATA (FY97-98)

FY 1997									
	Arresting Gear Labor Costs	Arresting Gear Material Costs	Arresting Gear Overhead Costs	Catapult Labor Costs	Catapult Material Costs	Catapult Overhead Costs	Landing Systems Labor Costs	Landing Systems Material Costs	Landing Systems Overhead Costs
CV-0062	-	-	-	40,856	9,578	53,180	-	-	-
CV-0063	6,430	1,628	6,770	100,960	216,199	115,699	7,839	53,434	9,295
CV-0064	20,017	17,885	27,555	304,825	273,233	393,441	38,857	107,140	52,944
CV-0065	-	-	-	-	-	-	-	-	-
CV-0067	119,412	237,163	226,669	131,635	261,439	249,871	9,305	18,482	17,664
CVN-0065	51,759	102,797	98,249	187,418	372,227	355,759	4,225	8,392	8,020
CVN-0068	14,946	1,951	13,755	77,197	183,049	70,968	20,125	26,950	24,762
CVN-0069	14,386	28,571	27,307	12,676	25,175	24,061	5,835	11,588	11,076
CVN-0070	26,898	29,197	36,965	2,263	15,489	2,727	757	43	999
CVN-0071	28,797	57,193	54,662	67,578	134,216	128,277	47,106	93,556	89,417
CVN-0072	37,873	26,419	46,142	44,191	40,664	51,227	18,347	4,127	22,735
CVN-0073	27,765	55,145	52,705	90,339	179,420	171,482	34,506	68,531	65,499
CVN-0074	1,107	2,198	2,100	66,748	132,557	126,702	402	799	764
CVN-0075	-	-	-	-	-	-	-	-	-
	349,391	560,147	591,879	1,126,686	1,843,256	1,743,394	187,304	393,042	303,175
Material Tot	2,795,445	0.393961254							
Labor Tot	1,663,381	0.234335981							
Overhead Tot	2,638,448	0.371702755							

FY 1998									
	Arresting Gear Labor Costs	Arresting Gear Material Costs	Arresting Gear Overhead Costs	Catapult Labor Costs	Catapult Material Costs	Catapult Overhead Costs	Landing Systems Labor Costs	Landing Systems Material Costs	Landing Systems Overhead Costs
CV-0062	-	-	-	31,726	22,782	29,666	-	-	-
CV-0063	39,031	31,604	34,979	89,673	173,178	88,080	52,753	215,999	53,448
CV-0064	109,297	343,381	101,338	340,954	409,704	286,872	86,810	488,153	79,966
CV-0065	-	-	-	-	-	-	-	-	-
CV-0067	63,409	150,045	111,621	315,731	747,117	555,794	31,282	74,024	55,068
CVN-0065	5,253	12,429	9,247	50,746	120,080	89,330	3,377	7,991	5,944
CVN-0068	-	-	-	22,347	42,263	22,141	-	-	-
CVN-0069	77,244	182,784	135,977	50,629	119,803	89,123	11,069	26,191	19,484
CVN-0070	111,581	210,286	98,386	117,675	245,171	58,028	22,924	97,284	22,119
CVN-0071	142,576	337,379	250,983	214,802	508,288	378,125	113,147	267,739	199,176
CVN-0072	74,104	167,023	70,842	179,550	421,415	175,132	141,774	31,288	32,226
CVN-0073	81,137	191,995	142,829	163,775	387,542	288,300	154,817	366,345	272,531
CVN-0074	34,612	81,903	60,929	91,267	215,967	160,662	2,814	6,669	4,954
CVN-0075	188	444	330	5,628	13,318	9,907	375	888	661
	738,432	1,709,273	1,017,461	1,674,513	3,426,628	2,231,160	621,142	1,582,551	745,577
Material Tot	6,718,462	0.488731043							
Labor Tot	3,034,067	0.220713089							
Overhead Tot	3,994,198	0.290555868							

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## APPENDIX J.

## VAMOSC ALRE COST DATA (FY99-00)

FY 1999									
	Arresting Gear Labor Costs	Arresting Gear Material Costs	Arresting Gear Overhead Costs	Catapult Labor Costs	Catapult Material Costs	Catapult Overhead Costs	Landing Systems Labor Costs	Landing Systems Material Costs	Landing Systems Overhead Costs
CV-0062									
CV-0063									
CV-0064	109,827	200,200	139,787	256,639	256,363	285,935	8,110	1,710	9,472
CV-0065									
CV-0067	108,493	335,320	209,040	148,655	192,063	285,425	36,147	55,068	69,647
CVN-0065	22,950	364,402	44,220	100,059	1,304,109	192,809	5,738	51,227	11,055
CVN-0068									
CVN-0069	19,612	7,110	37,788	129,722	120,315	249,944	6,937	2,900	13,367
CVN-0070	52,155	41,326	40,070	64,412	221,163	151,618	-	-	-
CVN-0071	74,198	398,171	142,951	97,331	137,243	187,533	4,173	-	8,040
CVN-0072	79,127	113,329	148,224	110,466	482	171,206	-	-	-
CVN-0073	27,853	185,676	53,657	67,954	36,375	130,952	7,928	1,950	15,276
CVN-0074	310,177	304,665	404,337	655,048	452,446	783,531	115,046	30,155	103,725
CVN-0075	10,015	1,925	19,255	57,053	31,980	109,947	7,511	376	14,472
	814,407	1,953,124	1,239,390	1,637,370	2,752,539	2,549,900	191,580	144,387	245,055
Material Tot	4,850,050	0.41891084							
Labor Tot	2,693,367	0.232632783							
Overhead Tot	4,034,345	0.348455377							

FY 2000									
	Arresting Gear Labor Costs	Arresting Gear Material Costs	Arresting Gear Overhead Costs	Catapult Labor Costs	Catapult Material Costs	Catapult Overhead Costs	Landing Systems Labor Costs	Landing Systems Material Costs	Landing Systems Overhead Costs
CV-0062									
CV-0063									
CV-0064	174,216	378,887	261,099	572,272	529,725	877,888	59,262	100,806	93,908
CV-0065									
CV-0067	95,640	72,019	104,753	438,651	594,157	481,771	98,505	98,679	107,891
CVN-0065	22,637	3,800	24,794	13,441	203,999	14,721	3,537	60,000	3,874
CVN-0068				10,754	1,304	18,739			
CVN-0069	49,483	267,215	54,197	197,329	91,577	216,131	4,527	6,776	4,959
CVN-0070	192,904	108,817	263,125	290,291	263,855	385,639	62,012	99,503	87,803
CVN-0071	225,413	412,736	246,890	218,021	317,254	238,793	267,645	419,943	293,145
CVN-0072	18,773	18,218	32,541	163,364	155,472	263,955	16,816	17,140	31,738
CVN-0073	85,702	217,322	93,857	6,897	76,500	7,554	565	7,500	620
CVN-0074	43,335	108,952	71,691	222,018	592,051	370,448	1,025	112,052	1,854
CVN-0075	31,338	181,200	34,324	42,309	101,713	46,333	18,285	1,557	20,029
	939,441	1,769,165	1,192,281	2,175,351	2,928,647	2,921,984	532,182	923,955	645,822
Material Tot	5,621,799	0.400730993							
Labor Tot	3,646,974	0.259952249							
Overhead Tot	4,760,087	0.339305758							



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